The Theory of Geographical Dimensions

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Abstract. The theory of geographical dimensions is an empirical theory. The author shows how the theory of geographical dimensions has been developed. Its core is a number of structural laws. It is a matter of objective, necessary, general and essential connections between geographical objects and geographical dimensions. The primary purpose of the theory is the concept of practicable models of geographical objects. The theory of geographical dimensions is an integral part of the geographic and cartographic theory.

Keywords: Geographic dimension, geographic object, geo-scientific space unit

1. Introduction

The geographical dimension is the heart of the theory of geographical dimensions. Neef defined this term as a scale range „in which the same assertions are possible, the same methodological objectives can be pursued, and a determined set of methods can be applied“(Neef 1963a, p. 361). He proposed three principal dimensions (a topologic, a chorologic and a geo-spheric dimension).

After Neef had shaped and defined the term “geographical dimension”, the theory of geographical dimensions could gain shape. Since the seventies this theory wanders about in technical literature. Herz (1973) created the term theory of landscape-analytic scale ranges, which can be seen as a preliminary version of the theory of geographical dimensions. Some 30 years ago, the geographical dimensions were then also taken into consideration for the generalization of maps. Sandner (1982) determined - using a model experiment (Bröcher 1978) - a scale hierarchy of natural landscape maps.

German dictionaries and encyclopaedias (Diercke-Wörterbuch 1997, Lexikon der Geographie 2002, Lexikon der Geowissenschaften 2002) all contain the keyword „Theory of the geographical dimensions“. Unfortunately they are all content with rather insufficient explanations.

At present, the German technical literature distinguishes six geographical dimensions (Steinhardt 2005). One subdivides the chorologic and the

regional dimension into various subordinated units. The dimensions and dimension subdivisions are valid as well for natural landscapes as for diverse components of it (table 1).

Dimensions	Dimension steps	Natural landscape units	Soil units
Global	---	Geo-sphere	Soil sphere
Zonal	---	Geo-zone	Soil zone
Regional	Macro-regional	Macro region	---
	Meso-regional	Mesoregion	---
	Micro-regional	Microregion	Soil region
Chorological	Mega-chorological	Megageochore	Great soil landscape
	Macro-chorological	Macrogeochore	Soil landscape
	Meso-chorological	Mesogeochore	Soil association
	Micro-chorological	Microgeochore	Dominant soil form society
	Nano-chorological	Nanogeochore	Soil form society
Topological	---	Geo-ecotope	Soil form
Sub-topological	---	---	---

Table 1. Dimensions of natural landscape units and soil units.

2. Method

The theory of geographical dimensions is an empirical theory. Like any theory it should serve two purposes, namely to explain known facts, and to predict facts presently unknown. A methodological path runs from empirical sentences over general sentences and hypotheses to laws. Empirical sentences are the material to start from. At first, the latter are systematized and subsequently generalized. If the general sentences are able to explain the empirical sentences, then hypotheses are formed. Afterwards it will be tested, whether - using these hypotheses – findings so far unknown can be derived from an application. Whenever observations, experiments and the like prove full correctness, a hypothesis can be confirmed. Likewise laws can be formed. The laws stand opposite to the hypotheses. Finally, the laws are imbedded into a wider system. Such a system is called a theory (Klaus 1971).

2.1. Empirical Sentences

The empirical sentences refer to natural landscape units. The author, former head of the working group “natural household and regional character” at the Saxon Academy of Sciences to Leipzig and lecturer at the TU Dresden, is concerned with these theses since the nineteen sixties. Exemplary empirical sentences may be given:

- The geographical dimensions are, so to speak, doors to a consideration or handling (analysis, synthesis, representation) of natural landscape units.
- The resolution depends on the distance between the subject and the natural landscape units.
- The distance is variable.
- etc.

2.2. General Sentences

The empirical sentences are now generalized. Specific relations exist between natural landscape units and the geographical dimensions. They are characterised with the following general sentences:

- Every geographic dimension is a function of the distance between the subject and the natural landscape units.
- Every geographic dimension bears a hierarchical rank. The longer the distance between the subject and the natural landscape units, the higher is the rank of the geographical dimension.
- Every natural landscape unit is an element of a geographical dimension.
- Every natural landscape unit is in the same time an element of a natural landscape unit within the next higher geographical dimension.
- Disregarding the exception of the basic natural landscape units, every natural landscape unit consists of a number of natural landscape units within the next lower geographical dimension.
- The natural landscape units of a given geographical dimension occupy the geo-sphere and do not overlap.
- Within any geographic dimension, the number of the natural landscape units is inversely proportional to the surface area.
- The rank of a geographical dimension is proportional to the surface area, and inversely proportional to the total number of the natural landscape units of this dimension.
- The natural landscape unit of any geographical dimension is in any case larger than the smallest natural landscape unit of the next lower geographical dimension.

After a confirmation the hypotheses transform into laws.

2.3. Hypotheses

A fundamental structural characteristic of natural landscape units is the occupation of a contiguous area without an overlap within any geographical dimension and any dimension level. The spatial units of other geo-components like, for instance, soil (table 1) have a similar characteristic. In this respect they fully correspond. Hence it follows: The laws relating to

natural landscape units are likewise valid for the spatial units of other geo-components (rock, climate, water, geo-relief, soil, vegetation). The specific space units constitute the class of the geo-scientific space units.

The laws now refer to the spatial units of an arbitrary geo-science:

- The geographical dimension is a function of the distance between the subject and the geo-scientific spatial units.
- Every geographical dimension bears a hierarchic rank. The longer the distance between the subject and the geo-scientific spatial unit the higher is the rank of the geographical dimension and vice-versa.
- Every geo-scientific spatial unit is an element of a geographical dimension.
- Every geo-scientific spatial unit is in the same time an element of a geo-scientific spatial unit within the next higher geographical dimension.
- Disregarding the exception of the basic spatial units, every geo-scientific spatial unit consists of a number of geo-scientific spatial units within the next lower geographical dimension.
- The geo-scientific spatial units of a given geographical dimension occupy the geo-sphere and do not overlap.
- Within any geographical dimension the number of the geo-scientific spatial units is inversely proportional to the surface area.
- The rank of a geographical dimension is proportional to the surface area and in inversely proportional to the number of the geo-scientific spatial units.

With a high probability, the same geographical dimensions and dimension levels can be expected in all other geo-sciences. But, apart from the case of soil, most dimension-specific spatial units are not at all established for other geo-components. This is a matter of fact in case of geological, hydro-geological, hydro-geographic, geomorphologic, climate and vegetation units as a spatial reference system of the cited natural landscape components. In future, dimension-specific spatial units will hopefully be discerned and explicitly be characterized in the fields of geology, hydrogeology, hydro-geography, geomorphology, climatology, soil science, geo-botany and zoo-geography.

3. The Theory in a Narrower Sense

The theory of geographical dimensions is a systematic ordered series of laws. They express specific relations and interrelations between geographic objects of the same object class and a geographic dimension. Laws are the most important parts of a theory. The principal purpose of this theory is the provision of practicable models of geographic objects.

Like any theory the one of the geographical dimensions consists of a system of basic terms, axioms and rules. With the help of them one defines further terms, and derives logical statements from the theory.

Neef (1967) has shaped the geographical axioms. The planetary axiom says: „All geographic facts are ... assigned to the planet earth and receive from this fact certain basic geographic characteristics“(Neef 1967, p. 20). The landscape axiom says: „At every spot [locus] on the earth' surface, elements, components and factors of the geographic substance are in a lawful mutual relationship“(Neef 1967, p. 22). The chorologic axiom says: „All geographic facts possess a geographic locus (space) which is distinctive by its position [and] ... positional relation to neighbouring loci (spaces)“(Neef 1967, p. 23).

Neef (1963, 1967) never indicated, that the geographic dimensions are also valid in cultural geography. Within the latter, one can discern such dimensions everywhere. This not only concerns the range but also the semantics and terminology of the geographic objects.

Finally we can generalize even further. The geo-scientific spatial units are replaced by geographic objects of the same object class. The fundamental area-structural characteristic of all geo-scientific spatial units serve as a scale. If such a characteristic exists, then the laws of the geo-scientific spatial units are valid for the geographic objects in a similar way. In the following, a range of the geographic objects of the same object class (such as administrative units) replaces the geo-scientific spatial unit.

- The geographical dimension is a function of the distance between the subject and the geographic objects of the same object class.
- Every geographical dimension bears a hierarchic rank. The greater the distance between the subject and the geographic objects, the higher is the rank of the geographical dimension.
- Every geographic object is an element of a geographical dimension.
- Every geographic object is in the same time an element of a geographic object of the same object class within the next higher geographical dimension.
- With the exception of the basic objects every geographic object of an object class is a number of geographical objects of the same object class within the next lower geographical dimension.
- The geographic objects of the same geographical dimension occupy the earth's surface and do not overlap.
- Within every geographical dimension the number of the geographic objects of the same object class is inversely proportional to the range.
- The rank of a geographical dimension is proportional to the range, and inversely proportional to the number of the geographic objects of the same object class.

However, numerous geographic objects have not the fundamental areal characteristic (occupation of a contiguous area without overlap) within all geographical dimensions. These objects almost exclusively belong to the field of human geography (such as the distribution of population, industry, dialects, confessions etc.). They have to be assigned to an adequate geographical dimension by reacting on the range of their meaning.

4. Conclusions

The theory of geographical dimensions consists of a number of structural laws. It is a matter of objective, necessary, general and consequently essential connections between geographical objects and geographical dimensions. They refer to object classes with the same structure and are explicit independent of time.

The geographical dimensions refer to the geographic space. Accordingly, they are valid not only for geography but also for all sciences which operate in and with geographical space (Leser 1991). The theory of geographical dimensions is an inseparable part of geographic and cartographic theory.

The history of the sciences teaches that an empirical theory like the theory of geographical dimensions is not necessarily right for good. It is relative truth, and will be replaced by means of relative truth of higher order in the course of time (Klaus 1971).

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